

ICHTHYOLOGY.—*Two new species of Anampses from the Hawaiian Islands, with notes on other labrid fishes of this genus.*<sup>1</sup> JOHN E. RANDALL, University of Miami. (Communicated by Leonard P. Schultz.)

(Received December 4, 1957)

More species of the family Labridae (wrasses) are known from the Hawaiian Islands than any other family of reef fishes. This preponderance is furthered in the present paper by the description of two more, both species of *Anampses* Quoy and Gaimard. A key to the four Hawaiian species of this genus and discussion of related forms from other regions of the tropical Indo-Pacific are also presented.

I wish to express my gratitude to Dr. William A. Gosline, of the University of Hawaii, for kindly providing the single paratypes of the two new species, with the prior knowledge that they probably represent undescribed forms, and to Dr. James E. Böhlke, of the Academy of Natural Sciences of Philadelphia, and Robert H. Kanazawa, of the United States National Museum, for pertinent information.

The holotypes of the two new species are in the United States National Museum (U.S.N.M.).

The genus *Anampses* is characterized as follows: Mouth small; lips moderately fleshy; a single pair of large, protruding, incisiform teeth anteriorly in the upper jaw and a similar, more medial pair in the lower jaw (the upper incisors are slightly longer and broader and the edges sharper than the lower incisors; the uppers project outward at an angle of about 45°, the lowers directly forward or slightly downward); remaining teeth minute, generally imperceptible; body compressed, moderately deep (the depth contained about 2.5 to 4.0 times in standard length); head scaleless; body with moderately large scales (subgenus *Pseudanampses*<sup>2</sup> excepted) except for region of nape and thorax where the scales are small; 27 to 29

scales in lateral line (49 to 51 in *Anampses* (*Pseudanampses*) *geographicus*); lateral line continuous, angling down sharply at the level of about the ninth dorsal soft ray; gill membranes attached to isthmus; preopercle entire; dorsal fin rays IX, 12 (rarely 11 or 13); anal fin rays III, 12 (rarely 11 or 13); pectoral fin rays 13 (the uppermost a bony splint); caudal fin truncate, slightly emarginate, or slightly rounded; colorful Indo-Pacific species of moderate size (some attaining 300 mm. in standard length).

#### KEY TO THE HAWAIIAN SPECIES OF ANAMPSES

- 1a. Body relatively deep, depth contained about 2.5 to 2.8 times in standard length; caudal fin truncate..... 2
- 1b. Body not deep, depth contained about 3.3 to 4 times in standard length; caudal fin slightly rounded in adults..... 3
- 2a. Each scale of body with a prominent round white spot..... *Anampses cuvieri* (Fig. 1)
- 2b. Each scale of body with a narrow vertical blue line..... *Anampses godeffroyi* (Fig. 2)
- 3a. Body without white spots; head pale (bright orange in life with blue bands) and contrasting sharply with darker body; caudal fin not paler than body.  
*Anampses chrysocephalus*, n. sp. (Fig. 3)
- 3b. Body with white spots (one per scale below lateral line, several per scale above); head not paler than body; caudal fin markedly paler than body (in life red distally and white basally).  
*Anampses rubrocaudatus*, n. sp. (Fig. 4)

#### *Anampses chrysocephalus*, n. sp.

##### Fig. 3

*Holotype*.—U.S.N.M. no 164465, a male, 151.5 mm in standard length and 181.5 mm in total length, obtained by J. Randall on June 19, 1953, from a fisherman whose traps were set in about 30 to 90 feet of water from Kewalo Basin to Koko Head, Oahu, Territory of Hawaii.

*Paratype*.—University of Hawaii no. 2152, a male specimen, 139.5 mm in standard length and 168.5 mm in total length, obtained by W. Gosline in January 1950 from the Honolulu Aquarium.

<sup>1</sup> Contribution no. 195 from the Marine Laboratory, University of Miami.

<sup>2</sup> Jordan and Snyder (1902: 628) proposed *Ampheces* as a subgenus for the species *Anampses geographicus* Cuvier and Valenciennes; *Pseudanampses* Bleeker (1862: 101), however, has priority.

The majority of the aquarium fishes are purchased from trap fishermen. The specimen is in poor condition. It was preserved after being discovered dead on the bottom; sufficient time had elapsed for partial decomposition to occur.

*Description.*—Based on the holotype and one paratype. Counts and measurements are recorded for the holotype, followed in parentheses by data for the paratype if different from that of the holotype. Measurements were not made of the fins of the paratype.

Dorsal fin rays IX,12; anal fin rays III,12] pectoral fin rays 13 (the uppermost rudimentary, the next unbranched); pelvic fin rays I,5; principal caudal rays 14. Lateral line scales 28, 19 in the anterior part, 2 in the part which is bent sharply downward at the level of the ninth dorsal soft ray, and 7 in the peduncular part; a single row of large scales between anterior part of lateral line and dorsal fin and 7 rows between anterior part of lateral line and anal fin (a few small scales occur between the uppermost and lowermost rows of body scales and the dorsal and anal fins, respectively; however no scales are present basally on these fins); a patch of small scales basally on caudal fin posterior to large body scales; head naked; small scales on nape poorly developed or imbedded; triangular area from isthmus to upper base of pectoral fin and origin of pelvic fins covered with small distinct scales; gill rakers on first gill arch 13 (paratype only).

Head length 2.96 (2.90); depth of body 3.36 (3.34); snout to anus 1.83 (1.81); snout to origin of pelvic fins 2.64 (2.58); snout to origin of dorsal fin 3.21 (3.03); length of dorsal fin base 1.56 (1.55); length of anal fin base 2.53 (2.54)—all in standard length.

Width of body at gill opening 2.43 (2.64); least depth of caudal peduncle 2.59 (2.69); snout length 2.80 (2.75); diameter of eye 7.10 (6.89); width of interorbital 3.93 (4.00); length of pectoral fin 2.22 (fins frayed on either side, thus probably shorter than normal); length of pelvic fin 1.82; width of mouth (rictus to rictus) 5.68 (5.44); mid-center of upper lip to most posterior part of upper lip 6.01 (6.02); edge of eye to upper end of free margin of preopercle 7.35 (7.39); first dorsal spine 7.63; second dorsal spine 5.38; ninth dorsal spine 3.29; first dorsal soft ray 2.79; first anal spine 12.2; second anal spine 6.96; third anal spine 5.16; first anal soft ray 3.06—all in head length.

Profile of head with a slight indentation just anterior to a vertical through forward edge of eye; lips moderately fleshy; dentition characteristic of the genus, the length of the upper pair of incisors 2.2 in eye diameter, that of the lower pair 3.2 in eye diameter; upper teeth nearly touching at their base; space between lower pair of teeth contained about 3 times in eye diameter (no other teeth could be found in the jaws—only a bony plate which is exposed when the lips are pulled outward); a well-developed opercular flap, its length posterior to opercle equal to eye diameter; gill membranes attached to isthmus with a small free fold across it dorsal and anal spines slender but pungent; posterodistal ends of dorsal and anal fins pointed; caudal fin slightly rounded.

Color in alcohol: head light tan, almost white with irregular, dark-edged, light bluish-gray bands and spots; a large black spot on membranous opercular flap; body brown, the center of each scale darker than the edges; an elongate, lobed, dark-edged, bluish-gray spot on nape extending across demarcation of pale head and brown body, the part on the body partially surrounded by a narrow pale region (this region continuous with a middorsal pale band about an eye diameter in width which extends anteriorly from origin of dorsal fin); dorsal fin dark brown with a distinct but narrow white margin; anal fin brown, shading outwardly to light yellowish brown, with a narrow pale margin, a thin submarginal dark line, and pale blue blotches (there is a large elongate blotch basally on each interradial membrane and a lesser spot or spots distal to the large one); caudal fin dark brown; pelvic fin rays brown, the membranes pale; pectoral fin pale, brown at extreme base; a pale spot on upper part of axil of pectoral fin.

In life the head was brilliant orange with black-edged, iridescent blue bands and spots; body dark orangish brown with a vertically elongate grayish green spot on posterior border of each scale; lobed blue spot on nape surrounded by a narrow bright lemon yellow area which is continuous with a yellow middorsal band on nape; lips and adjacent portion of snout light tan; dorsal and caudal fins dark brown, the dorsal with a narrow white margin; anal fin brown, shading in outer part to yellow, with blue blotches, a narrow white margin, and a thin dark brown submarginal line; pectoral fin hyaline, dark brown at base; axil of pectoral blue dorsally

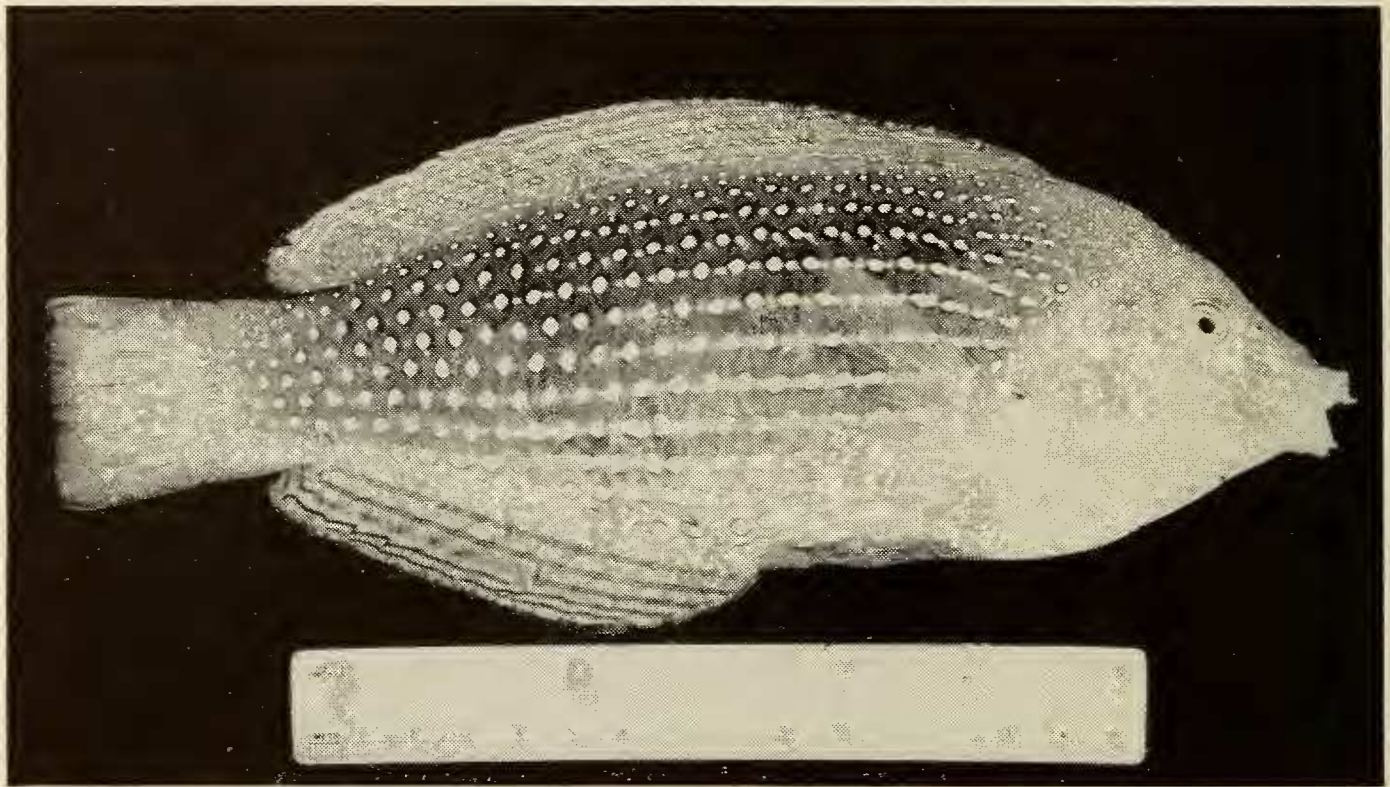


FIG. 1.—*Anampses cuvieri* Quoy and Gaimard: From a 35-mm color transparency of a fresh specimen. Standard length, 210 mm.

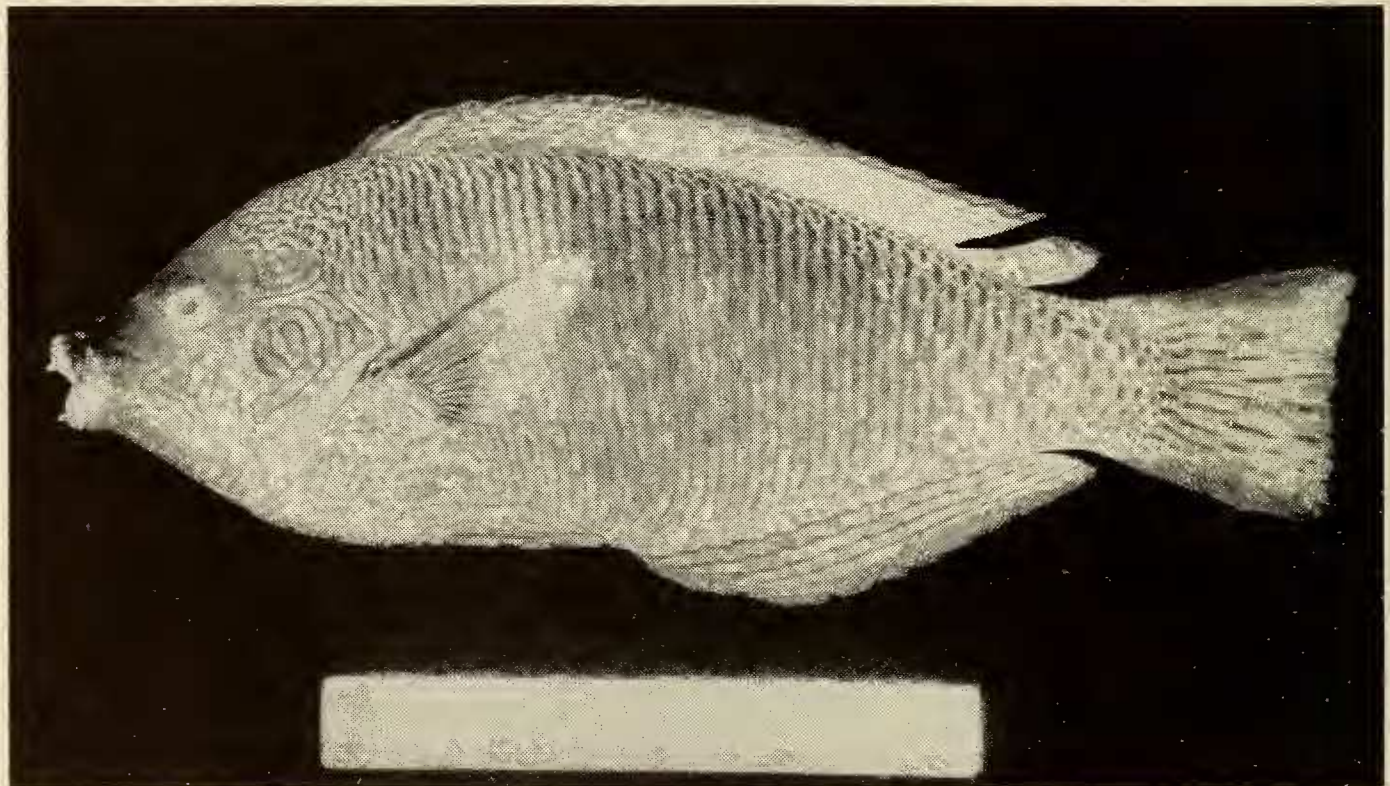


FIG. 2.—*Anampses godeffroyi* Günther: From a 35-mm color transparency of a fresh specimen. Dorsal fin split. Standard length, 268 mm.

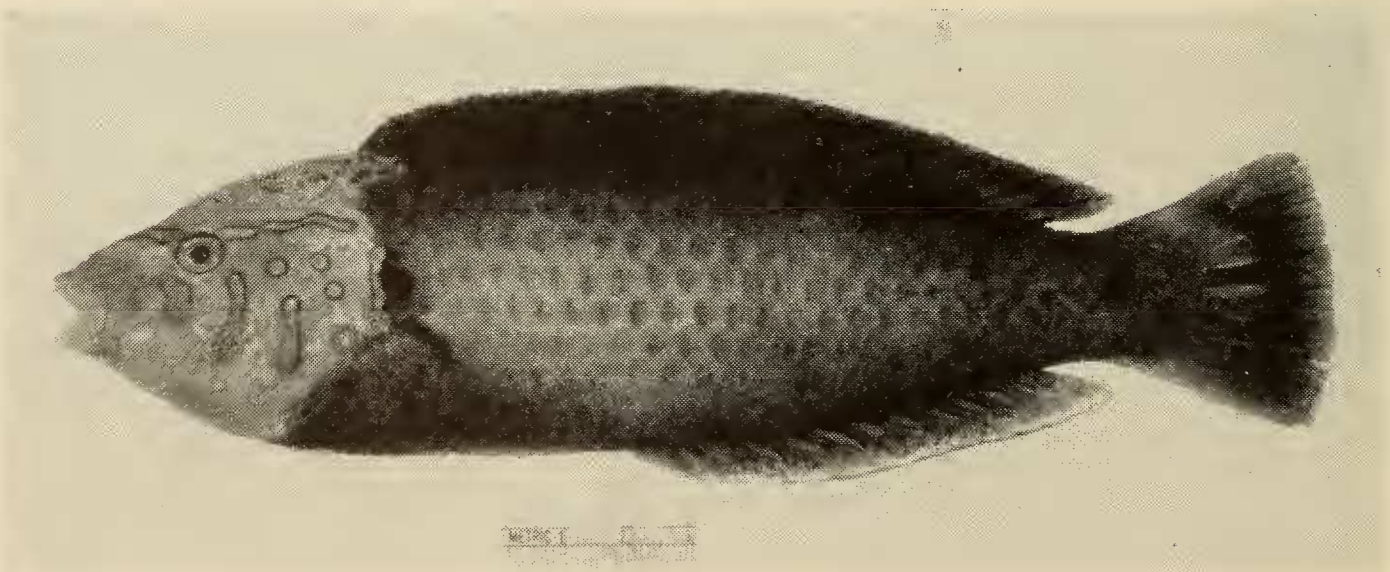


FIG. 3.—*Anampses chrysocephalus*, n. sp.: From a 35-mm color transparency of the holotype when fresh. Standard length, 151.5 mm.

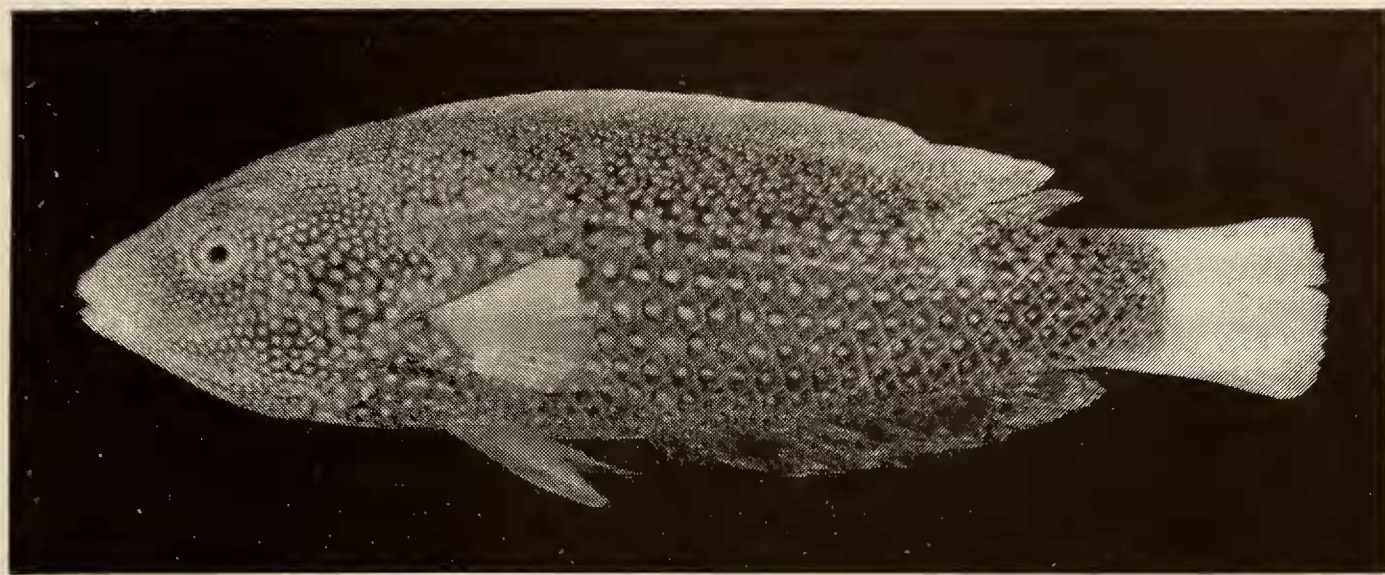


FIG. 4.—*Anampses rubrocaudatus*, n. sp.: From a photograph of the holotype after preservation by W. Courtenay. Pectorals abraded and injury evident on back at rear base of dorsal. Standard length, 137.7 mm.

orange in midsection, shading to pale lavender ventrally.

Vernon E. Brock, director of the Division of Fish and Game of the Territory of Hawaii, has informed me that he has observed *Anampses chrysocephalus* to be moderately common at depths of about 100 feet on the Waianae coast, Oahu.

Named *chrysocephalus* (Greek χρυσός, gold; κεφαλή, head) in reference to the striking coloration of the head.

Of the species of *Anampses*, *A. chrysocephalus* appears to be most closely related to *A. melanurus* Bleeker, also an elongate species with a black spot on the opercular membrane. *A. chrysocephalus* is distinct from *melanurus* in its smaller eye, shorter third anal spine relative to longest dorsal spine, and color. Instead of a pale head with darker irregular spots, *melanurus* has a dark head with light spots; also *melanurus* has a spotted dorsal fin and a light caudal fin with a broad dark subterminal vertical band (after de Beaufort, 1940: 103, no specimens seen by me).

***Anampses rubrocaudatus*, n. sp.**

Fig. 4

*Holotype*.—U.S.N.M. no. 160624, a female, 137.7 mm in standard length and 166 mm in total length, obtained from S. Tinker of the Honolulu Aquarium, Oahu, Territory of Hawaii, 1950.

*Paratype*.—University of Hawaii no. 2291, 82.6 mm in standard length and 108.5 mm in total length, collected by personnel of the Division of Fish and Game, Territory of Hawaii, by spearing off Waianae, Oahu, at a depth of about 90 feet, in 1956.

*Description*.—Based on the holotype and one paratype. Counts and measurements are recorded for the holotype, followed in parentheses by data for the paratype if different from that of the holotype.

Dorsal fin rays IX,12; anal fin rays III,12; pectoral fin rays 13 (outer portion of fins absent in holotype); pelvic fin rays I,5; principal caudal rays 14. Lateral line scales 28, 19 in anterior portion, 2 in part which angles downward at level of base of ninth dorsal soft ray, and 7 in peduncular part; a single row of large scales above lateral line (above this a second row about one-half as large, and between the latter row and the dorsal fin a few small scales, these more numerous anteriorly); 8 rows of large scales below lateral line to origin of anal fin (plus a few small scales next to fin); 7 large scale rows between lateral line and more posterior part of anal fin; small scales present on base of caudal fin, thorax, and ventral part of abdomen; no median predorsal scales, but a few small imbedded scales more laterally on nape; head naked; gill rakers on first arch 20 (holotype only).

Head length 2.86 (2.98); depth of body 3.29 (3.95); snout to anus 1.86 (paratype not measured); snout to origin of pelvic fins 2.73 (paratype not measured); snout to origin of dorsal fin 2.98 (paratype not measured); length of dorsal fin base 1.58 (1.62); length of anal fin base 2.60 (2.95)—all in standard length.

Width of body at gill opening 2.46 (2.77); least depth of caudal peduncle 2.69 (3.11); snout length 3.12 (3.34); diameter of eye 7.17 (5.32); width of interorbital 3.93 (4.62); length of pectoral fin 1.80 (paratype only); length of pelvic fin 1.77 (2.18); width of mouth (riectus to

rictus) 5.11 (6.93); mid-center of upper lip to most posterior part of upper lip 5.16 (5.04); edge of eye to upper end of free margin of preopercle 7.17 (paratype not measured); first dorsal spine 8.00 (7.78); second dorsal spine 5.51 (paratype not measured); ninth dorsal spine 3.20 (3.30); first dorsal soft ray 2.40 (2.91); first anal spine 9.60 (10.6); second anal spine 6.00 (8.70); third anal spine 4.70 (4.95); first anal soft ray 2.74 (2.98)—all in head length.

Profile of head smooth; lips fleshy, the edges rounded and firm; no membranous flap extending from ethmoidal part of snout over groove posterior to upper lip to rest on base of upper lip; dentition characteristic of genus, the length of the incisors of the holotype 2.6 mm; upper incisors of holotype separated by 1.7 mm and lowers by 0.7 mm; a well-developed opercular flap, its length posterior to opercle equal to eye diameter; gill membranes attached to isthmus with a small free fold across it; dorsal and anal spines flexible in holotype, pungent in paratype; posterodistal ends of dorsal and anal fins pointed; caudal fin slightly rounded.

Color in alcohol: dark brown (the head of the paratype a little darker than the body) with a white spot in center of each scale below the lateral line; scales in lateral line and above lateral line with about 4 to 6 white spots; head with numerous small white spots, those on snout, interorbital, and nape very small and close-set; unscaled portion of caudal fin white; dorsal fin brown with numerous small white spots and a white border; anal fin dark brown with a few scattered faint white dots, especially at base, and a very narrow white margin; pectoral fins white, the base brown with white spots; pelvic fins with a broad brown lateral edge, light brown rays, and hyaline membranes; lips whitish, the base of the upper lip light brown with small white spots.

Life color of the holotype of *A. rubrocaudatus* from a 35-mm color transparency on file in the United States National Museum: Dark chocolate brown with white spots; outer half of caudal fin bright red, basal half white; pectoral pink; lips pinkish; inner portion of iris orange-yellow.

Like *A. chrysocephalus*, this species appears to be restricted to moderate depths on Hawaiian reefs.

Named *rubrocaudatus* (Latin *rubro*, combining form of *ruber*, red; *caudatus*, tailed) in reference to the prominent red color on the outer half of the caudal fin.

This species is most closely allied to *Anampses meleagrides* Cuvier and Valenciennes, known from East Africa to the East Indies, Philippines, Riu Kiu Islands, and possibly Japan (the species *Anampses ikedae* and *A. nagoyoi* described by Tanaka from Kagoshima, Japan, may be synonyms of *A. meleagrides*). The similarity is so great that it seems probable that *meleagrides* gave rise through isolation in Hawaii to *rubrocaudatus*. *A. rubrocaudatus* differs from *meleagrides* in having a larger mouth (the width of the mouth of the 137.7 mm holotype measures 9.3 mm; of a 136-mm Philippine specimen of *meleagrides* 6 mm; the length of the upper jaw of *rubrocaudatus* is 10.7 mm, of the *meleagrides* specimen, 8.7 mm); lips which are more fleshy and firm (the edges of the lips of *meleagrides* are thin and supple); lacking a frenum extending from the ethmoidal part of the snout over the groove posterior to the upper lip and overlapping the basal part of the upper lip (this flap in *meleagrides* makes the lips seem even smaller than they actually are), having a slightly rounded instead of slightly emarginate caudal fin, and color as follows: several white spots per scale in lateral line and above (single spot per scale in *meleagrides*); spots on head and on dorsal fin smaller and more numerous; spots on anal fin tiny and indistinct; lips pale (brownish in *meleagrides*); no white line at base of pectoral fins as in *meleagrides*; caudal fin red and white in life (yellow in life in *meleagrides*).

*A. meleagrides* may have a white-edged black spot posteriorly on the dorsal and anal fins. Insufficient specimens have been examined to determine if this is a juvenile or sexual character. It appears to be a juvenile character in *Anampses cuvieri* Quoy and Gaimard from the Hawaiian Islands. A specimen 46 mm in standard length has a prominent ocellated black spot on the hind part of the dorsal and anal fins; on a 70-mm specimen the anal ocellus is gone and the dorsal ocellus just disappearing.

As indicated in the key, the four Hawaiian species of *Anampses* are easily distinguished one from another, although color characters, of necessity, have been emphasized.

Both *A. cuvieri* and *A. godeffroyi* Günther<sup>3</sup> are portrayed in color in Günther's *Fische der Südsee*

<sup>3</sup> As was suspected by Jordan and Evermann (1905: 294) and Jordan and Seale (1906: 296), *Anampses evermanni* Jenkins is a synonym of *A. godeffroyi*.

(1881: pls. 136 A and 140, respectively), although somewhat inaccurately. The spots on the body of *A. cuvieri* should be white instead of blue. *A. godeffroyi* is depicted as pale blue with a vertical blue line on each scale and numerous irregular dark blue markings on the head. The true life color (as based on a specimen 268 mm in standard length from Hawaii) is as follows: Body grayish brown with vertical blue lines on scales; anterodorsal quadrant of head (enclosing eye) bright green; remainder of head grayish brown with tortuous, narrow, dark blue lines, those on nape small and not interconnected; dorsal and anal fins brownish gray with prominent bright blue margins and narrow lengthwise dark blue lines; caudal fin colored like body on basal half, orange-yellow on outer half, with short horizontal blue lines and broad blue upper and lower margins; pectoral fin grayish brown on basal half and orange-yellow on outer half, with a blue line on upper margin; iris red and the lips flesh-colored.

Previously *A. godeffroyi* was known only from the Hawaiian Islands, except for one uncertain record from the Society Islands by Fowler (1928: 332) based on two specimens in the Museum of Comparative Zoology. Of these Fowler wrote, "Though dark and vertical lines little distinct these specimens evidently this species, not previously known from outside Hawaii." I have recently collected this species from the Society Islands and Tuamotu Archipelago and can thus verify Fowler's record. Specimens are catalogued at the United States National Museum under the number 164602 and at the Natural History Museum, Stanford University, under the number 48870. In French Oceania this wrasse was observed only in relatively shallow (generally less than 20 feet) outer reef areas exposed to the action of surf. On several occasions while I was attempting to spear individuals of this species, they retreated to the inshore ends of surge channels and disappeared in the white water of the surf. In Hawaii the species is usually seen in deeper, less turbulent water.

*A. godeffroyi* has a vertical blue line on each scale of the body in the Society Islands as in Hawaii; however, there are some differences in color between the species in the two island groups. The life colors of a 200 mm specimen from Tahiti are as follows: Body iridescent greenish brown, the edges of the scales dark olive, with a vertical bright blue narrow line on each scale

except on the nape, thorax, abdomen, and scaled portion of caudal fin, where blue spots replace the blue lines (ground color on abdomen purplish and on thorax pale turquoise); head dull olive-green, purplish on opercle, shading to pale turquoise ventrally with widely spaced narrow bright blue lines, two of which are nearly horizontal and run from snout through eye almost to end of opercle; dorsal fin greenish yellow basally, shading to copper up to the blue margin (which occupies about one-tenth the width of the fin), with about three irregular rows of small blue spots; anal similar to dorsal, but with a broader blue margin (about one-fourth width of fin); caudal fin with broad bright blue upper and lower margins and eight blue horizontal bars interspersed with orangish areas; upper edge of pectoral fin blue, then a region of hyaline copper shading to pale yellow on lower part of fin; pelvic fins blue-edged with a median blue band separating lateral copper and medial pale yellow areas; iris yellow with shades of iridescent green. A color marking readily seen underwater on the species but not noticeable when the fish are removed from the water is a light greenish area dorsally on caudal peduncle.

The most notable differences of the Society Islands specimens from the Hawaiian are the discrete instead of interconnected blue lines on the head, the lack of the anterodorsal green area on the head, and rows of small spots on the dorsal and anal fins instead of solid blue lines. In view of the similarity of the two forms, the differences mentioned are believed to be subspecific and not specific in magnitude.

As might be expected from the isolation of the Hawaiian Islands, due not only to distance but also to the direction of ocean currents, minor color differences are frequently seen between a species of reef fish in Hawaii and elsewhere in the Indo-Pacific area. In some species the color differences are not so minor and may be coupled with differences in counts or proportional measurements. A point is reached where a taxonomist feels impelled to recognize the Hawaiian form as a distinct species. Unfortunately, opinions vary as to the degree of differentiation necessary to establish a species in Hawaii as distinct. This problem, of course, is not confined to Hawaii and the tropical Pacific, but I shall restrict the present discussion to this area. Some authors, to give but a few examples, regard *Chromis dimidiatus* (Klunzinger). *Macro-*

*pharyngodon geoffroy* (Quoy and Gaimard), and *Acanthurus triostegus* (Linnaeus) in Hawaii as not specifically different from these species elsewhere in their range, whereas others recognize them as full species by the names *C. leucurus* Gilbert, *M. meleagris* (Cuvier and Valenciennes), and *A. sandvicensis* Streets (for details of these species pairs, see Randall, 1955 and 1956). Some authors have preferred to regard a Hawaiian form as a full species when a character, even if only a small spot of color, provides complete separation of the Hawaiian material from that elsewhere in Oceania. Since no insular stepping stones join the Hawaiian chain with islands to the south and west, it is not possible to demonstrate typical subspecific intergradation at some intermediate place, but this does not mean that the subspecific concept cannot be applied. I do not agree with Gosline (1955: 469) who wrote, "It was felt that intergradation between the Hawaiian endemics and their Central Pacific counterparts would occur at Johnston if anywhere. If does not occur there (or elsewhere among any of the fishes here investigated, and on the basis of absence of intergradation (the term is here used in contrast with introgression) the Hawaiian endemics must be considered full species." As this author has indicated (p. 479), the Johnston Island fish fauna is essentially Hawaiian (as its proximity to Hawaii would suggest); therefore I do not believe the absence of intergradation at Johnston is a strong indication of full specific rank of the Hawaiian forms in question. There does not seem to be equal opportunity for the Central Pacific counterparts to meet the Hawaiian forms at Johnston. In my opinion the best criterion on which to base the assigning of a name to a Hawaiian variant consists of drawing inferences from the degree of differentiation of other closely related species in the same genus (if they exist) which occur together. Naturally this is imperfect, for a Hawaiian form, although distinguished morphologically only slightly, or perhaps not at all, from the species in non-Hawaiian areas, may have differentiated physiologically or ecologically such that natural interbreeding would be impossible.

As long as the morphological differences between Hawaiian and related non-Hawaiian forms are noted, it might be argued that it is unimportant whether opinions differ as to how to recognize them nomenclatorially. In a sense this is true; however I believe the conservative approach (namely, the recognition of the Hawaiian forms as

subspecies or varieties when differences are slight, even though constant) is preferred, for it results in fewer specific names with which to contend and is less misleading from a zoogeographical standpoint.

*Anampses cuvieri* is known only from the Hawaiian Islands where, like many of the endemic fishes, it is abundant. The common *Anampses caeruleopunctatus* Rüppell is in continuous distribution from the Red Sea and east Africa eastward throughout all Oceania except Hawaii.<sup>4</sup> These two species are very closely related. Their similarity first became apparent to the writer when the life colors of *caeruleopunctatus* were noted in collections from the Society Islands, Tuamotus, and Marquesas (the species is previously unrecorded from the latter two island groups; specimens have been deposited in the United States National Museum, and Natural History Museum at Stanford University). A 180-mm specimen from Tahiti was olive, shading to reddish ventrally, the edges of the scales darker, with a single bright blue spot, edged in blackish, in the center of each scale; head marked with similar spots and dark-edged blue bands (more bands and fewer spots on large specimens); dorsal fin dark copper with narrow bright blue margin, dark submarginal line, and approximately three rows of small dark-edged blue spots; anal fin bright red with a margin like the dorsal and two rows of small dark-edged blue spots, one at the base and one half way out in fin; caudal fin dark reddish brown with blue edges and blue spots as on body but slightly larger; pectoral fins hyaline with pale yellow rays; pelvic fins red with blue lateral edge and two blue blotches; lips reddish. *A. caeruleopunctatus* differs from *A. cuvieri* in having blue instead of white spots, in lacking small intermediate spots between some of the larger ones centered in each body scale (this giving more of a linear effect on *cuvieri*), in having principally blue bands on the head instead of small spots, in having a spotted caudal fin and rows of spots instead of solid lines in the dorsal and anal fins; the dorsal and anal fins are pointed posteriorly in *caeruleopunctatus* and slightly rounded in *cuvieri*; *caeruleopunctatus* (Society Islands and Tuamotus) has 21 or 22 gill rakers on the first

<sup>4</sup> The two specimens of *A. caeruleopunctatus* (U.S.N.M. no. 71657) listed from Japan by Fowler and Bean (1928: 230) were collected in Okinawa, Riu Kiu Islands. Kamohara (1954: 46, fig. 11) has recorded the species from Japan.

gill arch and *cuvieri* 19 or 20. The above differences are probably great enough to warrant the recognition of two species, but the similarity in other characters and the distribution of the species suggests that *caeruleopunctatus* may have been the progenitor stock which gave rise through independent evolution of a Hawaiian population to *A. cuvieri*.

Although Fowler (1928: 333) correctly placed *Anampses pulcher* Regan from Easter Island in the synonymy of *caeruleopunctatus*, he created another synonym when he described *Anampses tinkhami* from the Riu Kiu Islands (1946: 162). Dr. James E. Böhlke provided the author with information on the type of *A. tinkhami* in the Academy of Natural Sciences of Philadelphia.

Another species of *Anampses*, *A. twistii* Bleeker, with a type locality of Ambon, East Indies, was collected in the Society Islands and was sighted in the pass at the atoll of Takaroa in the Tuamotu Archipelago. Previously this species was known from the central Pacific from one 80-mm specimen taken at Fiji (as *Anampses fidjensis* Sauvage, 1880: 224). Dr. Leonard P. Schultz, of the United States National Museum, will record the species from the northern Marshall Islands in volume 2 of *Fishes of the Marshall and Marianas Islands*. Recently Kamohara (*op. cit.*) has recorded it from Japan and Smith (1955: 931) from the western Indian Ocean. The Society Islands specimen was taken with a spear in the lagoon of Moorea at a depth of 40 feet. It measures 83 mm in standard length, and is catalogued in the United States National Museum under number 114743. In life the fish was purple on most of the body and upper half of the head; the lower half of the head and the thorax up to the pectoral base was yellow (the demarcation between purple and yellow being gradual, not abrupt); body and nape covered with small, black-edged blue spots (few, however, occurring on thoracic region); caudal peduncle and caudal fin dull orange-red with a broad whitish posterior margin and small pale blue spots (spots lacking on outer third of fin); dorsal and anal fins reddish purple, shading to copper distally and posteriorly (the anal with shades of yellow anteriorly in middle of fin), with small dark-edged blue spots and a conspicuous blue-edged black spot, in diameter nearly twice as great as eye, in the posterior part of each fin; dorsal and anal fins margined narrowly with blue anteriorly and black posteriorly; paired fins yellow, the pectorals with a dark brown band

at the base; opercular membrane darker than rest of head; lips orangish white. The body depth of the specimen is contained 3.3 times in the standard length; the upper pair of canine teeth are sharply upcurved and the lowers sharply downcurved. Individuals of the species nearly twice as large as this specimen were seen in the same area, as were juveniles. The blue spots on the latter were fewer and larger, and the bright yellow ventral coloration was lacking.

Specimens of the non-Hawaiian species, *Anampses diadematus* Rüppell, *A. amboinensis* Bleeker, *A. geographicus* Cuvier and Valenciennes, and *A. pterophthalmus* Bleeker were examined at the United States National Museum and the Natural History Museum, Stanford University. *A. diadematus* is suggestive of *godeffroyi* in having vertical pale lines on the scales and similar body proportions. It differs primarily in having predorsal scales (absent mid-dorsally on *godeffroyi*) and in possessing a distinctive pale band running forward from the eye across the front part of the interorbital space and a second, narrower band connecting eyes vertically across the interorbital.

*A. pterophthalmus* and *A. geographicus* differ from all other *Anampses* in having much higher scale counts (lateral line scales given by de Beaufort, *op. cit.* as 49–51). These two species differ from one another only in color and caudal fin shape, and it is believed that the former is the female and subadult male of the latter, although more specimens are needed to demonstrate this conclusively. *A. geographicus* is the older name. Mostly females and a few males were found among the museum specimens of *pterophthalmus* which could be sexed. The largest specimen is 166.5 mm in standard length. Seven males and no females were identified among 16 specimens of *geographicus* which could be sexed. With the exception of one disconcerting 107-mm specimen (sex indeterminable) the *geographicus* ranged from 150 to 199 mm in standard length. *A. pterophthalmus* has a truncate caudal fin and a large, black, white-edged spot posteriorly in the dorsal and anal fins. Except for the 107-mm specimen which has a truncate caudal fin, all of the *geographicus* have emarginate caudal fins with slightly produced lobes. *A. geographicus* is a more colorful species, has a vermiculation of narrow bands on the head and chest, and ordinarily lacks ocelli in the fins. Fowler and Bean (*op. cit.*: 227) recorded one specimen from Cebu, Philippine Islands, with



obscure ocelli on the last dorsal and anal rays. The specimen is 152 mm in standard length, and its caudal fin is slightly emarginate. This fish appears to be transforming from the *pterophthalmus* form to that of *geographicus*.

## LITERATURE CITED

- BEAUFORT, L. F. DE. *The fishes of the Indo-Australian Archipelago*. 8: xv + 508, 56 figs. Leiden, 1940.
- BLEEKER, P. *Atlas ichthyologique . . . néerlandais* 1: xxi + 168, 48 pls. Amsterdam, 1862.
- FOWLER, H. W. *The fishes of Oceania*. Bernice P. Bishop Mus. Mem. 10: iii + 540, 49 pls., 82 text figs. 1928.
- . *A collection of fishes obtained in the Riu Kiu Islands by Captain Ernest R. Tinkham* A.U.S. Proc. Acad. Nat. Sci. Philadelphia 98: 123-218, 76 figs. 1946.
- and BEAN, B. A. *Contributions to the biology of the Philippine Archipelago and adjacent regions*. U. S. Nat. Mus. Bull. 100(7): vii + 525, 49 pls. 1928.
- GOSLINE, W. A. *The inshore fish fauna of Johnston Island, a Central Pacific atoll*. Pacific Sci. 10: 442-480, 4 figs. 1955.
- GÜNTHER, A. C. *Andrew Garrett's Fische der Südsee*. Journ. Mus. Godeffroy 7 (15): 217-256, 20 pls. 1881.
- JENKINS, O. P. *Description of new species of fishes from the Hawaiian Islands belonging to the families of Labridae and Scaridae*. U. S. Fish Comm. Bull. 19: 45-65, 22 figs., 1 pl. 1900.
- JORDAN, D. S., and EVERMANN, B. W. *The aquatic resources of the Hawaiian Islands. Part I. The shore fishes*. U. S. Bur. Fish. Bull. 23 (1): xxviii + 574, 229 figs., 65 pls., 73 col. pls. 1905.
- and SEALE, A. *The fishes of Samoa*. U. S. Bur. Fish. Bull. 25: 175-455 + xxx, 111 figs., 5 pls., 16 col. pls. 1906.
- and SNYDER, J. O. *A review of the labroid fishes and related forms found in the waters of Japan*. Proc. U. S. Nat. Mus. 24: 595-662, 10 figs. 1902.
- KAMOHARA, T. *A list of fishes from the Tokara Islands, Kagoshima Prefecture, Japan*. Seto Mar. Biol. Lab. Publ. 3: 265-299, 17 figs. 1954.
- QUOY, J. R. C., and GAIMARD, P. *Voyage autour du monde . . . 1817-20*. 1-712, atlas. Paris, 1824.
- RANDALL, J. E. *Fishes of the Gilbert Islands*. Atoll Res. Bull. 47: xi + 243, 2 figs. 1955.
- . *A revision of the surgeon fish genus Acanthurus*. Pacific Sci. 10: 159-235, 23 figs., 3 col. pls. 1956.
- REGAN, C. T. *A collection of fishes made by Professor Francisco Fuentes at Easter Island*. Proc. Zool. Soc. London 1913: 368-374, 6 pls.
- SAUVAGE, H. E. *Description de quelques poissons de la collection du Muséum d'Histoire Naturelle*. Soc. Philom. Paris Bull. (7) 4: 220-228. 1880.
- SMITH, J. L. B. *The fishes of Aldabra. Pt. IV*. Ann. Mag. Nat. Hist. (12) 8: 928-937, 1 pl., 1 fig. 1955.
- TANAKA, S. *Notes on some Japanese fishes, with descriptions of fourteen new species*. Journ. Coll. Sci. Imp. Univ. Tokyo 23: 1-54, 4 pls. 1908.

## COCKROACHES AND DISEASE

Cockroaches are highly dangerous potential carriers of human disease. This is stressed in a report by Drs. Louis M. Roth and Edwin R. Willis, of the Quartermaster Research and Engineering Center, recently issued by the Smithsonian Institution. At least 18 species of cockroaches known to inhabit houses have been incriminated, naturally or experimentally, in transmission of infectious agents, or have been claimed to bite man. Several of the commonest species have been captured repeatedly in sewers, cesspools, and septic tanks and have been found migrating from sewers and dumps into nearby buildings. The predilection of cockroaches for human food is notorious. Thus, the two scientists point out, the mechanism certainly exists for transference of disease organisms to man and domestic animals.

Natural transmission has not, however, been incontrovertibly proved. Four strains of polio virus, however, have been found occurring naturally in wild-caught cockroaches. In addition they can harbor, experimentally, Coxsackie, mouse encephalomyelitis, and yellow-fever viruses. About 40 species of disease-causing

bacteria have been isolated from naturally contaminated cockroaches, and two species of fungi that have been associated with human maladies have been found.

"There is no question," say the Quartermaster Corps scientists, "about the ability of cockroaches to carry pathogens in or on their bodies. . . Although they undoubtedly are vectors of the agents of viral and bacterial diseases, with very few exceptions their relations to specific outbreaks of disease have not been determined. This area of research has not received the attention it deserves. Demonstrating correlations between house flies and incidence of intestinal disease has been difficult. Linking cockroaches with the actual transmission of similar disease agents will be no easier.

"Cockroaches are tough, resilient insects with amazing endurance and ability to recover rapidly from almost complete extermination. They will probably always be with us, and we can only temporarily reduce their numbers. But, as in all battles, recognition of a common enemy is essential to successful combat."